



FLAAR
MESOAMÉRICA

TOXIC ROOT (TUBER)?

ARROWLEAF ELEPHANT EAR

Xanthosoma robustum



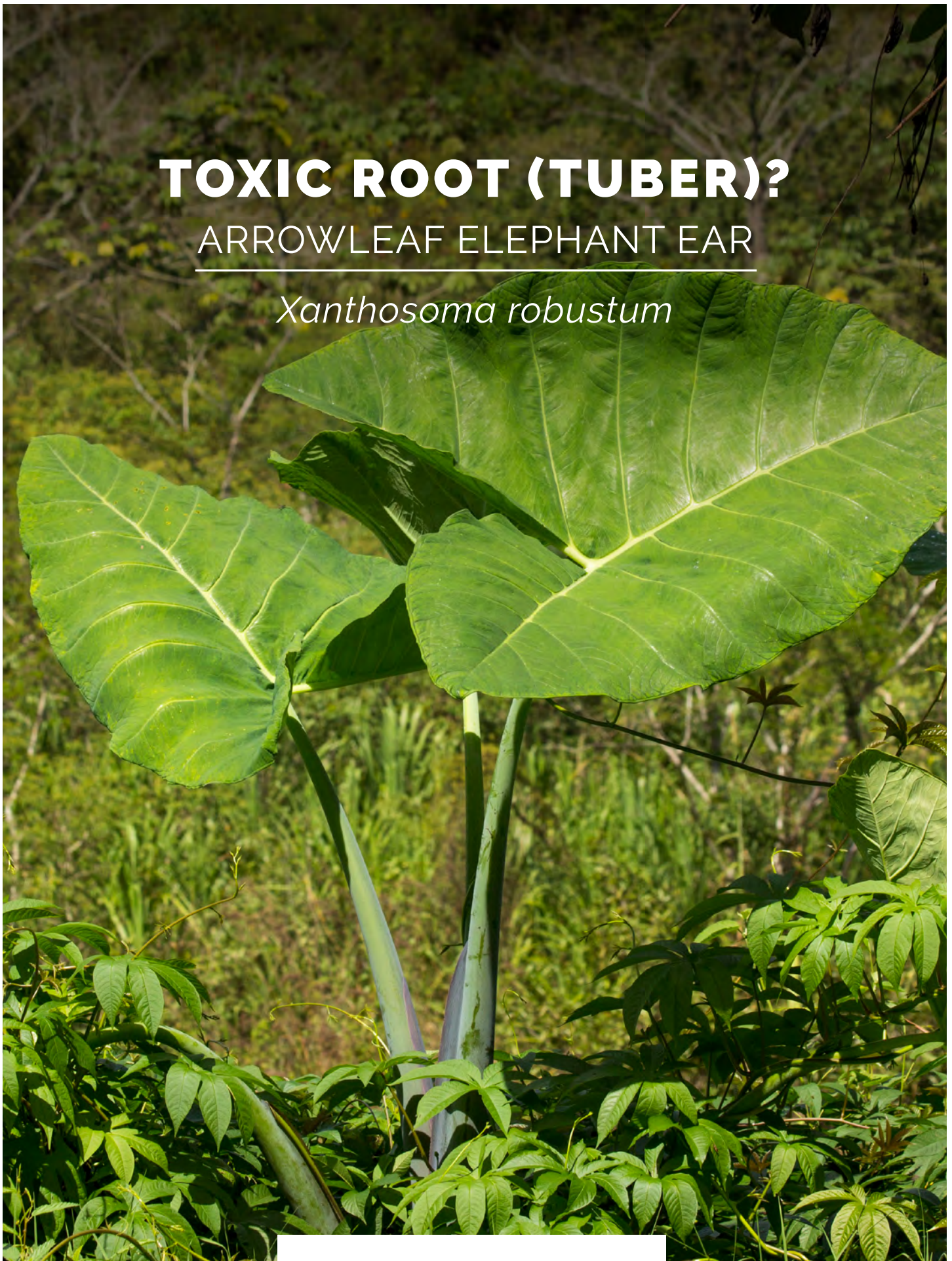
**Edible Root or Tuber available
for the Mayan People?**

NICHOLAS **HELLMUTH**

TOXIC ROOT (TUBER)?

ARROWLEAF ELEPHANT EAR

Xanthosoma robustum



JUNE 2021



CREDITS

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Photography by: David Arrivillaga, FLAAR Mesoamerica, Jan. 19, 2020, 12:07 p.m. La Tinta, Alta Verapaz, Guatemala. Camera: iPhone 12 Pro Max.

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We appreciate the donation of Dr John D. Dwyer's family (Chicago) in his honor and memory. Dr Dwyer was a botanist who worked in many areas of Mesoamerica, including the Yaxha area while the site was being mapped by FLAAR in the 1970's. The donation, provided in November 2021, has supported FLAAR research projects: the current FLAAR project of flora and fauna in Reserva de la Biosfera Maya (RBM) and the research in Municipio de Livingston, departamento de Izabal, carried out by FLAAR (USA) and FLAAR Mesoamerica (Guatemala).

This donation is also in recognition of the urgency and need for the conservation of both wildlife and rare plants within the biodiverse ecosystems of RBM in Guatemala, which includes Parque Nacional Yaxha, Nakum and Naranjo (PNYNN).

FRONT COVER PHOTOGRAPH

Xanthosoma robustum

Photography by: David Arrivillaga, FLAAR Mesoamerica, Jan. 19, 2020, 12:07 p.m. La Tinta, Alta Verapaz, Guatemala. Camera: Canon T3i. Lens: Canon EF 300mm IS II USM. Settings: 1/400 sec; f/8; ISO 200.

CONTENTS

Introduction to <i>Xanthosoma robustum</i> of Guatemala	8
My Personal Experience with <i>Xanthosoma robustum</i>	10
Full Botanical Name; Synonyms for <i>Xanthosoma robustum</i>	10
Mayan names for <i>Xanthosoma robustum</i>	11
Local names for <i>Xanthosoma robustum</i>	13
How many other plants of Guatemala have the same Spanish name?	13
Habit of <i>Xanthosoma robustum</i>	14
Habitat of <i>Xanthosoma robustum</i>	14
Where has <i>Xanthosoma robustum</i> been found in the Municipio of Livingston	18
• <i>Xanthosoma robustum</i> listed for Biotopo Protegido Chocón Machacas, CECON/USAC?	18
• Is <i>Xanthosoma robustum</i> listed for Tapon Creek Nature Reserve (including Taponcito Creek), FUNDAECO?	18
• Is <i>Xanthosoma robustum</i> listed for Cerro San Gil (south side of Río Dulce)?	18
• Is <i>Xanthosoma robustum</i> listed for Buena Vista Nature Reserve?	18
• Is <i>Xanthosoma robustum</i> listed for Ecoalbergue Lagunita Creek (Área de Usos Múltiples Río Sarstún)?	18
• Is <i>Xanthosoma robustum</i> listed for Sarstoon-Temash National Park (northern side of Río Sarstún)?	18
• Sierra Santa Cruz Special Protection Area (Subcuenca Río Sumachen)?	18



Are <i>Xanthosoma robustum</i> plants registered for Parque Nacional Tikal? _____	19
Brief list of <i>Xanthosoma robustum</i> trees for	
Belize by Standley and Record (1936)? _____	19
Botanical Description of the <i>Xanthosoma robustum</i>	
by Standley and Steyermark (1949) _____	20
Is <i>Xanthosoma robustum</i> from the Highlands or from the Lowlands (or both)? _____	25
<i>Xanthosoma robustum</i> in Mexico _____	25
<i>Xanthosoma robustum</i> in Chiapas _____	25
<i>Xanthosoma robustum</i> in Tabasco, etc _____	26
<i>Xanthosoma robustum</i> in Oaxaca _____	26
In what Ecosystem(s) can you find native <i>Xanthosoma robustum</i> ? _____	26
Do <i>Xanthosoma robustum</i> plants also grow in home gardens? _____	31
Uses of <i>Xanthosoma robustum</i> _____	31
Is there potential medicinal usage by local people? _____	36
Are any parts of <i>Xanthosoma robustum</i> plants eaten by mammals? _____	36
What are the primary pollinators of <i>Xanthosoma robustum</i> flowers? _____	36
Close relative(s) of <i>Xanthosoma robustum</i> _____	37
Summary and Comments on the use of <i>Xanthosoma robustum</i> as coagulant _____	38
Concluding Discussion and Summary on <i>Xanthosoma robustum</i> _____	43
Toxic <i>Xanthosoma</i> . _____	48
References Cited and Suggested Reading _____	49
Helpful web sites for any and all plants _____	59
Web sites specifically on <i>Xanthosoma robustum</i> _____	60







Xanthosoma robustum.

Photo by: Nicholas Hellmuth, FLAAR Mesoamerica, Jan. 30, 2021, 01:40 p.m. Cerro San Gil, Izabal, Guatemala.
Camera: iPhone 12 Pro Max

INTRODUCTION TO *XANTHOSOMA* ***ROBUSTUM* OF GUATEMALA**

While driving along the (formerly) unpaved road from Tamajú (Alta Verapaz, Guatemala) down the mountains to Tukurú; then down one more mountain range to the Polochic and Cahabón river area, you often see masses of giant “elephant ear” plants in humid areas. I assumed these were malanga or relatives.

One day I happened to read a mention of *Xanthosoma robustum* which said that its chemicals could be used to coagulate latex of native Maya rubber trees (*Castilla elastica*). Since we (the team of FLAAR (USA) and FLAAR Mesoamerica (Guatemala)) have been studying all the morning glory vine relatives that are better known to coagulate latex, I was instantly inspired to learn more about *X. robustum*. I noted that several botanists say that the root of *Xanthosoma robustum* is toxic and not eaten (of course, a plant does not have to be edible to be a chemical to coagulate latex). Since I am focused for decades on documenting wild native edible plants of the Maya Lowlands, I decided to start with the edible aspects and in the future work on the coagulating aspect separately. So, let’s look at the statements of botanists about whether the root/tubers are eaten or not. It is my impression that the roots are edible if cooked, but half the areas either don’t realize this or don’t care because they have so many other plants to eat, they don’t need to bother with getting rid of toxins by cooking.

The young leaves are said to be cooked and eaten in Guatemala, but the roots are regarded as poisonous.

(Standley and Steyermark 1958: 360, 361).

There are other ethnobotanists and botanists who often say that local people cook the root and then eat that also.

Credits for photo on page 6.
***Xanthosoma robustum*.**

Photo by Nicholas Hellmuth, FLAAR, Oct. 21, 2021, 1:59 p.m. FLAAR Ethnobotany
Maya Garden, Guatemala City. Camera: iPhone 13 Pro Max.



Xanthosoma robustum.

Photo by Nicholas Hellmuth, FLAAR, Oct. 21, 2021, 1:59 p.m.
FLAAR Ethnobotany Maya Garden, Guatemala City.
Camera: iPhone 13 Pro Max.



Xanthosoma robustum.

Photo by Nicholas Hellmuth, FLAAR, Oct. 21, 2021, 2:01 p.m.
FLAAR Ethnobotany Maya Garden, Guatemala City.
Camera: iPhone 13 Pro Max.

MY PERSONAL EXPERIENCE WITH ***XANTHOSOMA ROBUSTUM***

So, I realized that I had a lot of research to do in order to find out whether the roots of *Xanthosoma robustum* is edible or not. Since the young leaves are also listed by some botanists as being edible, and since this plant is very common in humid areas and along some rivers, I felt it was worthwhile to study this plant, both with library research and field work (to ask local Q'eqchi' people whether or not they eat or use this plant). Using the plant as a chemical coagulant to make rubber balls for the Mayan ballgames is a separate research project. The present FLAAR report is on the edible vs toxic properties of the roots.

FULL BOTANICAL NAME; SYNONYMS FOR ***XANTHOSOMA ROBUSTUM***

Xanthosoma robustum Schott is an accepted name and has no synonyms.

Family Araceae.



Xanthosoma robustum.

Photo by: Alejandra Gutiérrez, FLAAR Mesoamerica, Feb. 01, 2020, 11:40 a.m.
Senahú, Alta Verapaz, Guatemala.
Camera: iPhone 12 Pro Max.

MAYAN NAMES FOR *XANTHOSOMA ROBUSTUM*

Quequesque; Ququeshque; Marac... Called "quiscamote," "quiscamo," and "quiscamotillo" in Honduras, and "capote" in Chiapas. Los Quequexques is a caserío of the Department of Guatemala, and the vernacular name of the species appears in other local geographic names (Standley and Steyermark 1958: 360). The common name is spelled differently in earlier years: Quequexquic (Urbina 1906: 49). May depend on whether you are in a Nahuatl (Aztec) area of Mexico or a Mayan-language area far to the south. Another name by that same Mexican author is Ixtlilxochitl.

(Urbina 1906: 49).

Cho-cho, listed as local name for *Xanthosoma robustum* and used for food.

(Lucero, Harrison and Lindsay 2014: 240, #290 in list).

Local name depends on whether you realize which species of *Xanthosoma* is in front of you. Sometimes various species are given same names (this is why botanists use botanical names and not just popular names). It also depends on what local language your source speaks and on whether the malanga species of *Xanthosoma* is also present in the area where you are asking your questions.

We asked our Q'eqchi' Mayan gardener, Pedro. He comes from near Senahú, Alta Verapaz. His comments are as follows: "Marac" says Pedro, "because we have malanga and camote, we don't use Marac." "But other areas, different habitats, don't have malanga or camote, so they use Marac." "Leaves to eat; leaves as umbrella." "a person from Rabinal or El Quiche that I met, said that they eat the root; you have to cook it."

"You have to find a humid area; near a river. Then you can find these in the wild; with large leaves." (says Pedro). This is precisely what botanists say about *Xanthosoma robustum*, that it likes to grow in humid areas, especially near a river.

Linguist David Bolles provides additional local names for local *Xanthosoma yucatanense*:

macal nel) *Dioscorea* spp. - diosc.: akilxmacal, macalbox, maaxcalzodz. nel)
Xanthosoma yucatanense engler - arace.: cucutmacal, macal, xmacal -- com.

(2001: no pagination).



Xanthosoma robustum.

Photo by Nicholas Hellmuth, FLAAR Mesoamerica, Oct. 23, 2020, 1:57 p.m. FLAAR Ethnobotany Maya Garden, Guatemala City. Camera: iPhone 13 Pro Max.

LOCAL NAMES FOR ***XANTHOSOMA ROBUSTUM***

Quequexque, oreja de elefante is a common name you see on the Internet. Mafafa is another.

HOW MANY OTHER PLANTS OF GUATEMALA HAVE THE SAME SPANISH NAME?

“Oreja de elfante”, this name is given to the plants of the genus *Alocacia*.



Xanthosoma robustum.

Photo by: Nichollas Hellmuth, FLAAR Mesoamerica, Mar. 23, 2021, 11:40 a.m.
Río Dulce, Izabal, Guatemala.
Camera: iPhone 12 Pro Max.

HABIT

Herbaceous, perennial

HABITAT

Xanthosoma robustum grows along rivers in Chiapas

(Perez 2005: 159).

Other botanists say similar (for Chiapas):
“It occurs along slow-moving streams and wet, adjacent flats in temperate and lowland areas”.

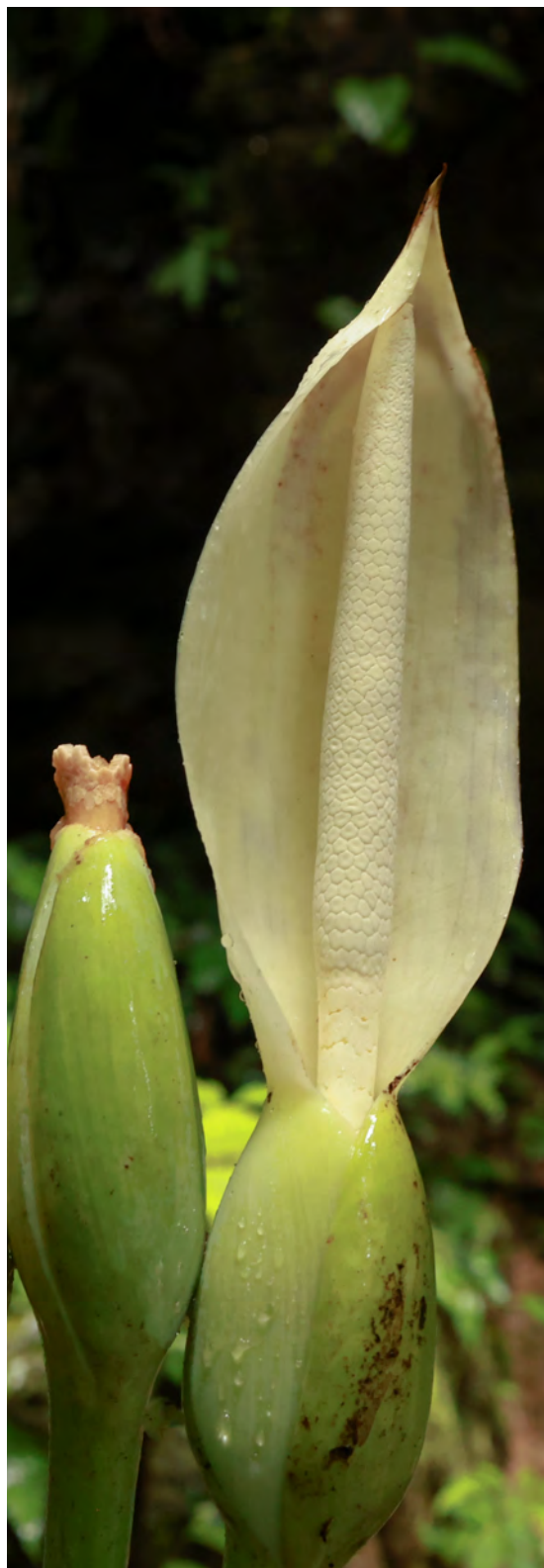
(Breedlove and Laughlin 1993: 251).

If you are hiking along a trail, or driving along a road in Alta Verapaz or Izabal, and there is a creek nearby, especially with a steep gully or several meters, I usually see the side of the gully filled with *Xanthosoma* plants near water level.

Xanthosoma robustum.

Photo by: Nichollas Hellmuth, FLAAR Mesoamerica, Jan. 19, 2021, 12:54 p.m. Cerro San Gil, Izabal, Guatemala.

Camera: iPhone 12 Pro Max.





Xanthosoma robustum.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Mar. 14, 2020, 11:13 a.m. Arroyo Petexbatún, Petén, Guatemala.
Camera: NIKON D5. Lens: 1AF-S VR Micro-Nikkor 105mm IF-ED. Settings: 1/800 sec; f/7.1; ISO 1,000.



Top and bottom of leaves of
Xanthosoma robustum.

Photo by Nicholas Hellmuth,
FLAAR Mesoamerica, Jan. 30,
2020. Senahú, south (downhill
to the south), after Panzos
turnoff. iPhone Xs.



Xanthosoma robustum.

Photo by: Alejandra Gutiérrez, FLAAR Mesoamerica, Jan. 28, 2021, 11:40 a.m. Senahú, Alta Verapaz, Guatemala
Camera: iPhone 12 Pro Max.

WHERE HAS *XANTHOSOMA ROBUSTUM* BEEN FOUND IN THE MUNICIPIO OF LIVINGSTON?

- > Is *Xanthosoma robustum* listed for Biotopo Protegido Chocón Machacas, CECON/USAC?

No mentioned

- > Is *Xanthosoma robustum* listed for Tapon Creek Nature Reserve (including Taponcito Creek), FUNDAECO?

No mentioned

- > Is *Xanthosoma robustum* listed for Cerro San Gil (south side of Rio Dulce)?
Only *Xanthosoma biolasium* species is mentioned as part of the main crops in the area, in the master plan for the period 2008-2012 (CONAP 2006).

- > Is *Xanthosoma robustum* listed for Buena Vista Nature Reserve?

No mentioned

- > Is *Xanthosoma robustum* listed for Ecoalbergue Lagunita Creek (Área de Usos Múltiples Río Sarstún)?

No mentioned

- > Is *Xanthosoma robustum* listed for Sarstoon-Temash National Park (northern side of Río Sarstún)?

No mentioned

- > Is *Xanthosoma robustum* listed for Refugio de Vida Silvestre Punta de Manabique?
It is recorded in Appendix 4 "Listado de Flora y Fauna" in the master plan for this protected area for the period 2002-2006 (CONAP 2001).

- > Is *Xanthosoma robustum* listed for Bocas de Polochic?

No mentioned

- > Sierra Santa Cruz Special Protection Area (Subcuenca Río Sumachen)?

In the flora list of the environmental management plan USAC (SALGUERO, Juana 2011).

ARE *XANTHOSOMA ROBUSTUM* PLANTS REGISTERED FOR PARQUE NACIONAL TIKAL?

Cyrus Lundell did not include mention of *Xanthosoma robustum* in any of his monographs on plants of the Petén of the 1930's. But a quarter century later he was still collecting plants in Petén, and he did in fact find one somewhere in or near Tikal:

- **Petén:** Tikal, ...3 Apr. 1959, Cyrus L. Lundell...;

(Croat, Delannay and Ortiz 2017: 551).

But so far no mention of *Xanthosoma robustum* in the Parque Nacional Yaxha, Nakum y Naranjo.

BRIEF LIST OF *XANTHOSOMA ROBUSTUM* TREES FOR BELIZE BY STANDLEY AND RECORD (1936)

Xanthosoma robustum is not listed for Belize by Standley and Record. Thus, perhaps no surprise that *Xanthosoma robustum* is not listed for Belize by Balick, Nee and Atha. Nonetheless, the absence of *Xanthosoma robustum* for Belize was unexpected since there are zillions of this plant throughout Alta Verapaz and many other areas of Guatemala. This is a gentle way of saying that surely *Xanthosoma robustum* can be found in Belize.

- And indeed, in year 2006, Bridgewater et al.

List *Xanthosoma robustum*

(2006: 286).

Lucero et al. also list *Xanthosoma robustum* (2014: 240, Table 1. Pool 1 Flora, plant #290).

They list this plant as food. Would be helpful, however, to ask that team whether other species of *Xanthosoma* could have been present, since other species "look nearly identical" to anyone who is not a botanist. I raise both species in my FLAAR Mayan Ethnobotanical Research Garden so that I can learn the differences. Plus we work with *Xanthosoma robustum* in wetlands of Alta Verapaz and now Izabal.

BOTANICAL DESCRIPTION OF THE *XANTHOSOMA ROBUSTUM* BY STANDLEY AND STEYERMARK (1949)

Xanthosoma robustum Schott, Oesterr. Bot. Wochenbl. 3:

370. 1853. *X. roseum* Schott, Oesterr. Bot. Zeitschr. 8: 178. 1858. Quequesque; Ququeshque; Marac (Coban, Quecchi). Figure 61. Wet soil, usually in marshy or boggy ground, in the open, in thickets, or in thin forest, 900 meters or lower, most plentiful at low elevations; Alta Verapaz; Izabal; Jalapa; Jutiapa; Santa Rosa; Escuintla; Chimaltenango; Huehuetenango; San Marcos; Quezaltenango; Retalhuleu. Honduras to Costa Rica.

Plants very large and conspicuous, the caudex usually procumbent, often 1-4 meters long and 10-20 cm. thick; petioles 40-180 cm. long or much longer, vaginate to the middle; leaf blades sagittate ovate, often two meters long but usually shorter, short-cuspidate, the basal lobes half as long as the anterior one, the blades glabrous, grass green above, pale beneath; tube of the spathe 6-10 cm. long, 6 cm. broad, oblong-ovoid, greenish, the limb twice as long, ovate-lanceolate, acute, greenish or whitish outside, white or pink within, 12-25 cm. long and 10-25 cm. wide; spadix stipitate 8 mm., slightly shorter than the spathe, the pistillate portion 3-4.5 cm. long, almost 2 cm. thick. Called "quiscamote," "quiscamo," and "quiscamotillo" in Honduras, and "capote" in Chiapas. Los Quequexques is a caserio of the Department of Guatemala, and the vernacular name of the species appears in other local geographic names. The plant grows most often in boggy soil near stream banks, where it sometimes forms wide colonies. Its large leaves make it very conspicuous, and the large spathes also are showy and rather handsome. The long thick trunks, which lie for part of their length flat on the ground, distinguish the plant from all other Central American Araceae. This species often is planted for ornament in gardens and parks. The huge leaves are used as protection against sudden showers. The young leaves are said to be cooked and eaten in Guatemala, but the roots are regarded as poisonous.

[Continues on the next page]

The boiled leaves are reputed to be given to nursing mothers to eat in order to stimulate the natural milk supply. The crude milky sap is used in some areas as a substitute for sulfur to coagulate wild rubber (castilla) in the fabrication of raincoats. Engler and Krause suggested that *X. roseum* may be only a variety of *X. robustum* (Das Pflanzenreich IV. 23E. 47. 1920), and recently Matuda (Las Araceas Mexicanas, in Anal. Inst. Biol. 24: 117. 1954) indicated his belief that *X. roseum* was probably synonymous with *X. robustum*. As the supposed differences in Engler and Krause's key (loc. cit. p. 42) between the two taxa do not appear to hold, as presently available material, at least, indicates, we are using the older name for the Guatemalan material, as suggested by Dr. Birdsey.

(Standley and Steyermark 1958:



Xanthosoma robustum.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Jan. 19, 2021, 12:54 p.m.

La Tinta, Alta Verapaz, Guatemala.

Camera: Canon T3i. Lens: Canon EF 300mm IS II USM. Settings: 1/400 sec; f/9; ISO 400.



Xanthosoma robustum.

Photo by Nicholas Hellmuth, FLAAR Mesoamerica, Oct. 23, 2020, 1:57 p.m. FLAAR Ethnobotany Maya Garden, Guatemala City. Camera: iPhone 13 Pro Max.



Xanthosoma robustum.

Photo by: Nichollas Hellmuth, FLAAR Mesoamerica, Mar. 23, 2021, 11:40 a.m. Rio Dulce, Izabal, Guatemala.

Camera: iPhone 12 Pro Max.



Xanthosoma robustum.

Photo by Nicholas Hellmuth, FLAAR Mesoamerica, Oct. 23, 2020, 1:57 p.m. FLAAR Ethnobotany Maya Garden, Guatemala City. Camera: iPhone 13 Pro Max.

IS *XANTHOSOMA ROBUSTUM* FROM THE HIGHLANDS OR FROM THE **LOWLANDS (OR BOTH)?**

Lowlands 900 meters or lower.

XANTHOSOMA ROBUSTUM **IN MEXICO**

- *Xanthosoma robustum* Schott AGS, CAM, CHIS, COL, CDMX, DGO, GRO, HGO, JAL, MEX, MICH, MOR, NAY, NLE, OAX, PUE, QRO, SLP, SIN, TAB, TAMS, VER, YUC, ZAC
- *Xanthosoma sagittifolium* (L.) Schott CHIS, COAH, MICH, NAY, NLE, OAX, PUE, QRO, QROO, SLP, TAB, VER

(Villaseñor 2016: 615)

XANTHOSOMA ROBUSTUM **IN CHIAPAS**

- Named "Vulture makal" (Cook 2016: 199). I suggest renaming it "Vulture Root".

Makal, *Xanthosoma robustum* Schott, "Los rizomas en sopas y atoles y los cogollos fritos o cocidos" (Chávez et al.). So again and again, this root/tuber/rhizome is indeed eaten by Mayan and other indigenous people of México and Guatemala.



***Xanthosoma robustum*.**

Photo by: David Arrivillaga, FLAAR
Mesoamerica, Jan. 19, 2020, 12:54 p.m. La Tinta,
Alta Verapaz, Guatemala.
Camera: Canon T3i. Lens: Canon EF 300mm IS II
USM. Settings: 1/400 sec; f/9; ISO 400.

***XANTHOSOMA ROBUSTUM* IN TABASCO, ETC.**

Yes, *Xanthosoma robustum* is present in Tabasco; Yes, it has been documented that *Xanthosoma robustum* is found in cocoa orchards and orchards. *Xanthosoma robustum* is even in the list of leaves that are sold in the village markets from Oaxaca and Chiapas

(Original text in Spanish, Castro et al. 2011: 22).

Plant highly appreciated by the Totonacos and Nahuas of the Sierra North of Puebla with which a stew called in Totonac paxnikak; grows in a tolerated way in coffee plantations and cornfields, and only the tender leaves are used, taking care to devein them very well.

(Original text in Spanish, Castro et al. 2011: 30).

***XANTHOSOMA ROBUSTUM* IN OAXACA**

The main form of management given to plants in orchards family members is ex situ, that is, in the orchards there are plants commonly domesticated but species also occur wild and weedy. The form of transplant management is common in medicinal plants, where most are wild from the cloud forest and are transplanted for cultivation; for instance, in the orchard HI are the dream grass (*Bomarea hirtella*), the taramundín (*Xanthosoma robustum*)

(Original text in Spanish, Manzanero, Flores and Hunn 2009: 17).

IN WHAT ECOSYSTEM CAN YOU FIND NATIVE *XANTHOSOMA ROBUSTUM*?

Xanthosoma robustum is rarely found in the forest, although it can sometimes be found in pastures and secondary forest on alluvial soils.



Xanthosoma robustum. Inflorescences "rise and fall" (buds and then dry out and rot away).

Photo by Nicholas Hellmuth, FLAAR Mesoamerica, Jan. 30, 2020. iPhone Xs.

Senahú, up in the mountains of Alta Verapaz, Guatemala; south (downhill to the south from Senaju), after Panzos turnoff.



Xanthosoma robustum. Here is an even better photo of the inflorescences of *Xanthosoma robustum* "rotting away." You will not likely see this in a herbaria specimen (unless it rotted after it was collected).

Photo by Nicholas Hellmuth, FLAAR Mesoamerica, Jan. 30, 2020. iPhone Xs.
Senahú, south (downhill to the south), after Panzos turnoff.



Xanthosoma robustum.

Photo by: Nichollas Hellmuth, FLAAR Mesoamerica, Jan. 19, 2021, 12:54 p.m. Cerro San Gil, Izabal, Guatemala.

Camera: iPhone 12 Pro Max.



Xanthosoma robustum.

Photo by Nicholas Hellmuth, FLAAR Mesoamerica, Oct. 23, 2020, 1:45 p.m. FLAAR Ethnobotany Maya Garden, Guatemala City. Camera: iPhone 13 Pro Max.

DO *XANTHOSOMA ROBUSTUM* PLANTS ALSO GROW IN HOME GARDENS?

Even though most botanists say the roots are toxic or poisonous, they are actually eaten (maybe cooking removes the toxicity?). So yes, *Xanthosoma robustum* is sometimes included in home gardens.

(Original text in Spanish, Vogl, Vogl-Lukasser and Caballero 2002: Table 4, page 640).

In other areas, *Xanthosoma robustum* is listed as "wild edible plants" (thus wild plants that are harvested and brought home for cooking and eating). Although the name of the list is "WILD edible plants"; in the comments section, it is listed as "grown". I take this to mean that local people find it in the wild and bring it to plant around their homes. These Achi Maya, from Río Negro (Guatemala), harvest the tender leaves for broth and in a tamale

(Original text in Spanish, Turreira et al. 2015: List 2).

USES OF *XANTHOSOMA ROBUSTUM*

Leaves can be used to wrap tamales (Turreira et al. 2015: Table 2).

Many or most of the aroids contain in their tissues needle-like crystals of calcium oxalate (at least it is usually so designated). When any portion of the foliage is chewed, these crystals penetrate the mouth tissues, often causing intense irritation and swelling. In the case of the Araceae used for food such as *Xanthosoma* and *Monstera* special care must be taken in their preparation. Fruiting spadices (such as those of *Monstera*) must be fully ripened, and tubers or rootstocks must be thoroughly exposed to heat in order to eliminate the pernicious crystals.

(Standley and Steyermark 1958: 304-305). Vol. 24, Part I

Yet Mayan people and others of México even sell the leaves of *Xanthosoma* in stacks in native indigenous markets. Perhaps the needle-like crystals of calcium oxalate are in the fruiting spadices and/or roots (and not in the leaves). I will ask botanist Dr. Thomas Croat about this.



Xanthosoma robustum.

Photo by: Nichollas Hellmuth, FLAAR Mesoamerica, Feb. 01, 2020, 09:51 a.m. Senahú, Alta Verapaz, Guatemala.
Camera: Nikon D810. Lens: Nikon AF-S Micro NIKKOR 60mm G ED. Settings: 1/40 sec; f/13; ISO 1,000.



Xanthosoma robustum.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Jan. 19, 2020, 12:54 p.m. La Tinta, Alta Verapaz, Guatemala.
Camera: Canon T3i. Lens: Canon EF 300mm IS II USM. Settings: 1/400 sec; f/9; ISO 400.



Nicholas Hellmuth next to *X. robustum* giant leaves for a size comparison.

Photo by: Alejandra Gutiérrez, FLAAR Mesoamerica, Feb. 01, 2020, 09:54 a.m. Senahú, Alta Verapaz, Guatemala.
Camera: Sony A7R (ILCE-7RM4). Lens: Sony FE 90mm Macro G OSS. Settings: 1/160 sec; f/3.2; ISO 320.



Xanthosoma robustum. These leaves are at a different angle to receive as much sun as possible.

Photo by Nicholas Hellmuth, FLAAR Mesoamerica, Jan. 30, 2020, 10:01 a.m. Senahú, south (downhill to the south), after Panzos turnoff. Camera: iPhone Xs.



Xanthosoma robustum. Here is a leaf beginning to unfurl. Herbaria specimens are essential for historical botanical research around the world. But I estimate that a digital photo archive, plant-by-plant, can provide additional information to help botanists (and students and the general public). You will not likely see a young leaf like this in a herbaria specimen.

Photo by Nicholas Hellmuth, FLAAR Mesoamerica, Jan. 30, 2020, 10:45 a.m. Senahú, south (downhill to the south), after Panzos turnoff. Camera: iPhone Xs.

IS THERE POTENTIAL MEDICINAL USAGE OF ***XANTHOSOMA ROBUSTUM*** BY LOCAL PEOPLE?

Yes, this plant has medicinal potential due to the chemicals in various parts of the plant. This would be a separate research project. Our first stage is to find edible and usable plants; when funds are available we can continue with medicinal plants (not only to cure a disease, but to help prevent it to begin with).

ARE ANY PARTS OF *XANTHOSOMA ROBUSTUM* PLANT EATEN BY MAMMALS?

The whole plant is toxic to animals. Severe irritant to digestive tract and mucous membranes; causes enteritis

(AVEDAÑO, Sergio and José Salvador FLORES 1999).

WHAT ARE THE PRIMARY POLLINATORS OF ***XANTHOSOMA*** FLOWERS?

Potentially pollinated by scarab beetles Goldwasser L. 2000. Scarab beetles, elephant ear (*Xanthosoma robustum*), and their associates.

(Natkarni and Wheelwright 2000)

Credits for photo on page 34.
***Xanthosoma robustum*.**

Photo by: Nichollas Hellmuth, FLAAR Mesoamerica, Jan. 19, 2020, 12:54 p.m. Senahú, Alta Verapaz, Guatemala.
Camera: Nikon D810. Lens: Nikon AF-S Micro NIKKOR 60mm G ED. Settings: 1/100 sec; f/11; ISO 800.

CLOSE RELATIVE(S) OF *XANTHOSOMA ROBUSTUM*

Xanthosoma yucatanense Engl. is listed by Villaseñor for CAM, QROO, YUC; so surely should be in adjacent Petén. Indeed, Lundell lists *Xanthosoma yucatanense* Engl. for Petén (1937: 54). But... *Xanthosoma yucatanense* Engl. is not listed by Standley and Steyermark for anywhere in Guatemala (1958). However, Atran et al. list *Xanthosoma yucatanense* as being present in milpas (2004: 138, Table 8). Atran and his team in Petén list *Xanthosoma yucatanense* as edible (Ibid. : 151 (without having to cook away toxins).

I estimate that *Xanthosoma yucatanense* is the most common edible plant of this species in the Yucatán peninsula, though so far can't find any *Xanthosoma* listed in any Calakmul area reports.

It is not often that Standley and Steyermark miss a plant; the reason is probably that all three species of *Xanthosoma* look so similar that you really have to be an expert in this genus to tell the differences.

Xanthosoma wendlandii (Schott) Schott is listed by Villaseñor for CHIS, COL, GRO, JAL, MEX, MICH, MOR, NAY, OAX, SIN, SON, TAB; if in Tabasco and Chiapas should be in adjacent Petén (2016). Standley and Steyermark do not include *Xanthosoma wendlandii* but list its synonym *Xanthosoma pedatum* Hemsl. but for the high high Highlands (Volcán de Fuego) (1958: 359). No volcanoes in Tabasco, so should show up someday in Petén.

Xanthosoma sagittifolium, malanga, usually listed under the synonym *Xanthosoma violaceum* is in Standley and Steyermark (1958: 362).

SUMMARY AND COMMENTS ON THE USE OF ***XANTHOSOMA ROBUSTUM* AS COAGULANT**

Xanthosoma robustum is not listed in Tarkanian and Hosler essential report America's First Polymer Scientists: Rubber Processing, Use and Transport in Mesoamerica (2011). *Merremia* is not listed either; only *Ipomoea alba* is listed. I learned about the two species of *Merremia* as latex coagulants first from Suzanne Cook's book on the Lacandón making rubber with either *Ipomoea alba* or one of the two species of *Merremia* (you don't need all three plants; any one works fine).

We have found all three plants at Parque Nacional Yaxha, Nakum, and Naranjo during 2018-2019. On our Livingston project so far the most common of the three is *Merremia umbellata*.

In his year 2003 M.S. thesis at MIT, Tarkanian does not list any species of *Merremia*, nor *Xanthosoma*. Nonetheless, all his theses are essential. Plus we appreciate that he answers all questions that we send to him by e-mail.

In one of the earlier reports by the MIT team (Hosler, Burkett and Tarkanian 1999), no *Merremia*, nor *Xanthosoma*. Nonetheless, if you are studying Olmec, Maya, and Aztec rubber, the research and publications by Tarkanian and colleagues at MIT are essential. In my several years library research on this topic I have found lots more sources for rubber and for coagulations, but *Ipomoea alba* is clearly the most common in coastal Chiapas area where Tarkanian worked. I raise *Ipomoea alba* and *Merremia tuberosa* around my office in Guatemala City. We have not yet found the other *Merremia* with seeds. Not many *Castilla elastica* trees in Izabal and only a few in Petén; most are in Alta Verapaz and the Costa Sur areas of Guatemala.

So, as we hike through remote areas of the Municipio de Livingston in future months of our 15-month project, we will continue looking for *Xanthosoma robustum*.

Xanthosoma robustum.





Xanthosoma robustum.

Photo by Nicholas Hellmuth, FLAAR Mesoamerica, Oct. 23, 2020, 1:41 p.m. FLAAR Ethnobotany Maya Garden, Guatemala City. Camera: iPhone 13 Pro Max.



Xanthosoma robustum.

Photo by Nicholas Hellmuth, FLAAR Mesoamerica, Oct. 23, 2020, 1:40 p.m. FLAAR Ethnobotany Maya Garden, Guatemala City. Camera: iPhone 13 Pro Max.



Xanthosoma robustum.

Photo by Nicholas Hellmuth, FLAAR Mesoamerica, Oct. 23, 2020, 11:14 p.m. FLAAR Ethnobotany Maya Garden, Guatemala City. Camera: iPhone 13 Pro Max.

CONCLUDING DISCUSSION AND SUMMARY **ON *XANTHOSOMA ROBUSTUM***

If you read botanical monograph by Standley and Steyermark, you are told *Xanthosoma robustum* is toxic or poisonous and so your natural inclination is (if you are studying edible foods), to simply skip this and go to the hundreds of other plants that are obviously more realistically edible.

But if you are stuck in the Houston airport for SIX hours and decide to study *Xanthosoma robustum* inside out, you find that over 80% of the articles on this plant list it as eaten (so “edible” and “toxic” are not always different; you can cook a toxic plant part and eat it without problem: look at cashew nuts!). I eat cashew nuts every month (but obviously not raw!).

And then you find that more than half the reports on kitchen gardens include *Xanthosoma robustum* in their lists, its rather obvious that *Xanthosoma robustum* is indeed edible (Heindorf PhD dissertation is an example, 2011: 113). Sugar cola and junk food are probably worse for your health.

After I came to the conclusion that *Xanthosoma robustum* should be added to edible native Maya food plants (after six hours of reading about this plant), I found that Pöll says this clearly: “Los rizomas crudos son tóxicos.” But you get rid of the bad chemicals “axalato de calcio, los cuales se destruyen por la cocción prolongada.” (Pöll 1983: 13).

Levy et al. simply lists *Xanthosoma robustum* as food (2006: 96). So I am glad I had many hours in the airport in Houston (late January 2020) because I could spend all these hours learning about this interesting plant. 99% of what I read mentioned edible or occasionally medicinal uses. Only 1% listed it as coagulant (and always citing Standley and Steyermark). So it would be helpful to learn from where and from whom Standley and Steyermark got this information. But this first edition (one year after Houston airport, in February 2021, no airports this year), my focus is on *Xanthosoma robustum* as edible leaves and edible root/tubers.

But let's quickly summarize its use also as a food. To overcome any author who dismisses *Xanthosoma* I close with an unexpected documentation of my hours, days, weeks or fieldwork and library research:

- 408 Malanga *Xanthosoma robustus*, Araceae, Alimenticio, ornamental
- 409 Macal *Xanthosoma sagittifolium*, Araceae, Alimenticio
- 410 Contí *Xanthosoma* sp. Araceae, Alimenticio, ornamental

(Mendez 2012: 54).

THREE SPECIES of *Xanthosoma* are not only listed as alimento (food) they are listed in a book on family gardens of the southeast of Mexico. Family gardens is same as kitchen garden: the gardens that surround most Mayan houses throughout the Lowlands and Highlands.

Let's rewrite the list of Maya foods. Today I saw another video showing Maya food sources as being, literally, maize, beans, and squash. Bronson added several root crops (our team has found over 400% more); Lundell added Ramón and Dennis Puleston popularized that with significant research. Our team has found over 400% more edible fruits and nuts of trees native to the Mayan-speaking areas.

And now we are adding lists of edible plants from swamps, marshes, bogs, and riverside/lakeside areas. Yes, the Maya occasionally engineered wetlands: but, we are going to document that so many edible plants grow in wetlands without needing engineering that books on foods to feed "millions of Maya" found by LiDAR can be more realistic.

Every part of the Maya Lowlands has different weather, different water levels, different ecosystems, and different local native edible plants. Diversity is the keyword; not just one tree, three milpa crops, and four root crops (the team here at FLAAR have found more hundreds of edible plants than I can count).

TOXIC *XANTHOSOMA*

Xanthosoma sp. And in general, the plants belonging to the ARACEAE family present harmful substances for human consumption. Oxalic Acid ($C_2H_2O_4$) is classified as an organic acid. It is a dicarboxylic acid that forms soluble and insoluble salts like oxalate ion and fulfills different functions in the plant, such as the formation of calcium oxalate crystals, which deposited on the leaves, could reflect solar radiation. Oxalates are present in the consumed parts of *Xanthosoma* sp.: leaves, fruits, seeds or underground structures; however, the consumption of foods with high concentrations of oxalates could have a negative effect, leading to kidney stones, due to the formation of calcium oxalate crystals. In addition, in women after menopause, the ability to absorb calcium decreases, and the consumption of foods rich in oxalate exacerbates this deficiency.

(Nina, Maldonado, Valenzuela, Tarqui, Ticano, Ghezzi & Almanza. 2020)



Symptoms: Burning when chewing produces, pain, drooling, nausea, vomiting, glottic edema, metabolic acidosis, hypocalcaemia, skin and eye irritation when contact

Asparagine ($C_4H_8N_2O_3$), is an amino acid found in this plant used as a nitrogen storage and transport molecule by many plants. It is, in fact, the major transporter of nitrogen in both the xylem and the phloem. In humans, this non-essential amino acid generally does not cause any side effects. However, pregnant and/or lactating women and people who have liver or kidney problems, should have a very exhaustive control of amino acids by a professional, since according to research it also has a close relationship with certain types of cancer and especially with breast cancer.

(Soriano. 2019)



Xanthosoma robustum.

Photo by: Alejandra Gutiérrez, FLAAR Mesoamerica, Feb. 01, 2020, 11:40 a.m. Senahú, Alta Verapaz, Guatemala.
Camera: iPhone 12 Pro Max.



Xanthosoma robustum

Photography by: David Arrivillaga, FLAAR Mesoamerica, Jan. 19, 2020, 12:07 p.m. La Tinta, Alta Verapaz, Guatemala.
Camera: Canon T3i. Lens: Canon EF 300mm IS II USM. Settings: 1/400 sec; f/8; ISO 200.



Xanthosoma robustum.

Photo by: David Arrivillaga, FLAAR Mesoamerica, Jan. 19, 2021, 12:54 p.m. La Tinta, Alta Verapaz, Guatemala.
Camera: Canon T3i. Lens: Canon EF 300mm IS II USM. Settings: 1/400 sec; f/9; ISO 400.

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Not available as a free download.

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www.mesoweb.com/es/articulos/sub/AM147.pdf

and

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He lists only one *Xanthosoma* and does not identify the species, though he estimates it may be violaceum (1972: 382).

Download on the Internet.



Xanthosoma robustum.

Photo by Nicholas Hellmuth, FLAAR Mesoamerica, Oct. 23, 2020, 1:41 p.m. FLAAR Ethnobotany Maya Garden, Guatemala City. Camera: iPhone 13 Pro Max.



Xanthosoma robustum.

Photo by Nicholas Hellmuth, FLAAR Mesoamerica, Oct. 23, 2020, 1:46 p.m. FLAAR Ethnobotany Maya Garden, Guatemala City. Camera: iPhone 13 Pro Max.

HELPFUL WEB SITES FOR **ANY AND ALL PLANTS**

There are several web sites that are helpful even though not of a university or botanical garden or government institute.

However, most popular web sites are copy-and-paste (a polite way of saying that their authors do not work out in the field, or even in a botanical garden). Many of these web sites are click bait (they make money when you buy stuff in the advertisements that are all along the sides and in wide banners also). So we prefer to focus on web sites that have reliable information.

<https://serv.biokic.asu.edu/neotrop/plantae/>

Neotropical Flora data base. To start your search click on this page:

<https://serv.biokic.asu.edu/neotrop/plantae/collections/harvestparams.php>

<http://enciclovida.mx>

CONABIO. The video they show on their home page shows a wide range of flowers pollinators, a snake and animals. The videos of the insects are great.

www.kew.org/science/tropamerica/imagetdatabase/index.html

Kew gardens in the UK is one of several botanical gardens that I have visited (also New York Botanical Gardens and Missouri Botanical Gardens (MOBOT), in St Louis. Also the botanical garden in Singapore and El Jardín Botánico, the open forest botanical garden in Guatemala City).

www.ThePlantList.org

This is the most reliable botanical web site to find synonyms. In the recent year, only one plant had more synonyms on another botanical web site.

WEB SITES SPECIFICALLY ON ***XANTHOSOMA ROBUSTUM***

<http://abrimaal.pro-e.pl/araceum/xanthosoma/robustum.htm>

Large photos, quality photos.

<https://davesgarden.com/guides/pf/go/162497/#b>

Shows one leaf is as large as a man standing next to it.

<http://enciclovida.mx/especies/162030-xanthosoma-robustum>

Photos and map showing distribution.

www.gbif.org/es/species/5330897

Photos, map distribution and information.

www.starrenvironmental.com/

[imagesearch/?q=Xanthosoma+robustum](http://www.starrenvironmental.com/imagesearch/?q=Xanthosoma+robustum)

Photos.

[http://worldplantsfotorevista.com/Espanol/xanthosomarobustum.](http://worldplantsfotorevista.com/Espanol/xanthosomarobustum.html)

[html](http://worldplantsfotorevista.com/Espanol/xanthosomarobustum.html)

Information.

ACKNOWLEDGEMENTS TO FLAAR MESOAMÉRICA

Flor de María Setina is the administrator of the office, she is in charge of several projects around the world (since FLAAR-REPORTS has been researching large format printers around the world for over 20 years.)

Vivian Hurtado Environmental engineer and the current project manager of FLAAR's divisions: Flora & Fauna and MayanToons. She is in charge of supervise daily activities in FLAAR, field trips, reports and track the results.

Victor Mendoza Identifies species of flora, fauna and fungi. Participates as a researcher in the office and sometimes on field trips

Andrea de la Paz is a graphic designer who helps propose art for the overall template and for aspects of our posts.

Senaida Ba Has been our photo assistant for several years. Now she prepares PowerPoint presentations for teachers and students on various topics of Flora, Fauna and Mayan Iconography

Jaqueline González is a designer who diagrams text and photos to create the current reports.

Roxana Leal Bachelor of Communication is the one who manages all our social networks and the digital community. He sometimes accompanies us on field trips because he likes the adventure and nature of Guatemala.

María Alejandra Gutiérrez She is an experienced photographer who today prepares the Photograph Catalogs for the current RBM project. He supported us with the coordination of the trips for the Livingston, Izabal project.

David Arrivillaga is an experienced photographer and can handle both Nikon and the latest Sony digital cameras. Their work during and after a field trip also includes sorting, naming, and processing.

Juan Carlos Hernández receives the material we write and puts it into Internet software to produce our web pages.

Paulo Núñez is a webmaster, overlooking the multitude of websites. Internet SEO changes every year, so we work together to evolve the format of our websites.

Valeria Áviles is an illustrator for MayanToons, a division in charge of educational material for schools, especially the Mayan Q'eqchi' schools in Alta Verapaz, Q'eqchi' and Peten Itza Maya in Peten, and the Mayan and Garífuna Q'eqchi' schools in the Municipality of Livingston, Izabal.

Josefina Sequén is an illustrator for MayanToons and also helps prepare illustrations for social media posts and animated videos.

Rosa Sequén is an illustrator for MayanToons and also helps to prepare illustrations for social media posts and animated videos.

Heidy Alejandra Galindo Setina is a designer who diagrams text and photos to create the actual reports.

Laura Morales is preparing animated videos in the style of MayanToons, as animated videos are the best way to help schoolchildren protect ecosystems fragile and endangered species.

María José Rabanales She has been part of the Flora y Fauna photographic reportage and educational material editing team since September 2020. He works together with others in the team to prepare the finished pdf editions of the Yaxhá Nakum Naranjo Project material.

Alejandra Valenzuela She is a biology student and is part of the editing team of photographic reports and educational material of Flora and Fauna since September 2020.

Alexander Gudiel designer who will join the editorial design team in December 2020. He will combine the text, images and maps in the FLAAR Mesoamerica editorial criteria.

Cristina Ríos is a design student who joins the editorial design team in December 2020. She will combine the text, images and maps in the editorial criteria of FLAAR Mesoamerica.

Carlos Marroquín is a graphic design student at USAC who volunteered to do his internship with the Editorial Design Team. We are very grateful to people like him who join our team and contribute their knowledge and work.

Sergio Jerez supports us with the identification of plants, bibliographic research and the generation of maps of the routes carried out in the expeditions

Edwin Solares is an environmental engineering student with a strong interest in ecology. He is a photographer and videographer during our expeditions and later edits this content to be able to use it in the materials we generate.

Belén Chacón Her work includes the ordering and tabulation of the useful and edible flora listed in the FLAAR bibliography and many other references, to make a complete list of useful plant species with updated taxonomic information

Diana Sandoval Her work is based on the collection of scientific information that shapes the reports that are published on our pages.

Paula García is part of our MayanToons Animation team. With his work he gives life and sounds to our favorite characters from the jungles, wetlands and savannahs of the region.

Niza Franco is part of our MayanToons Animation team. With his work he gives life and sounds to our favorite characters from the jungles, wetlands and savannahs of the region.

María José Toralla Collects information and bibliographic references to feed our electronic library of Flora & Fauna and support research for reports and websites

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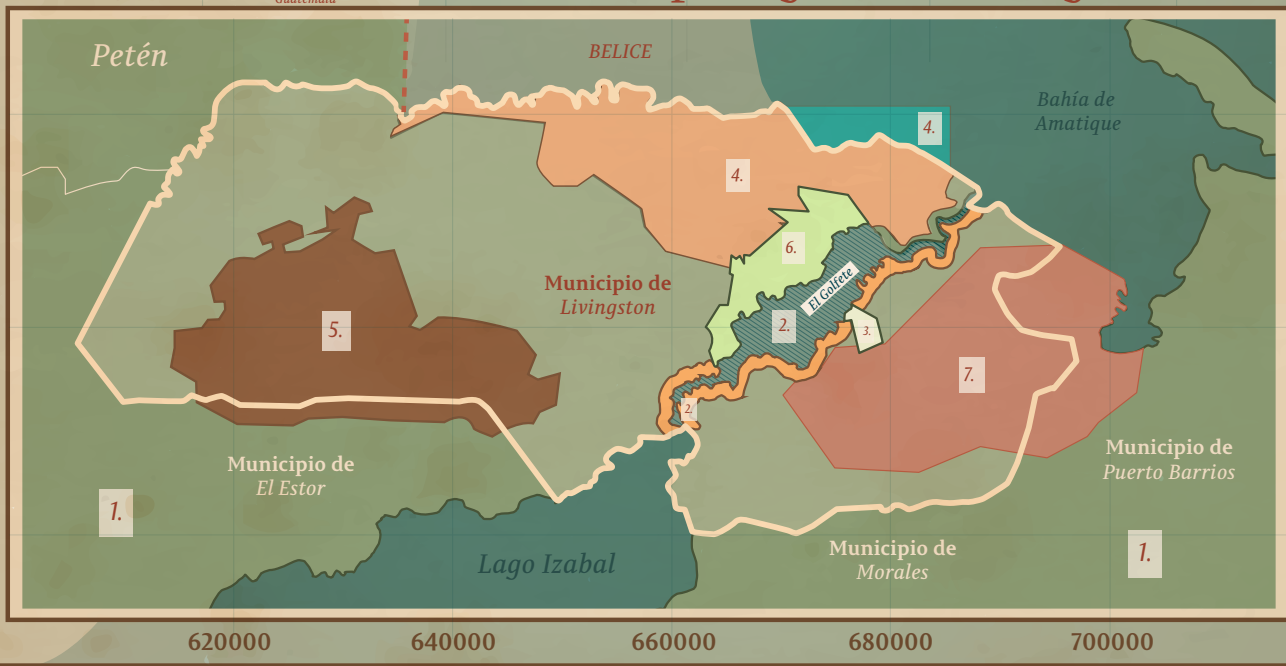
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Áreas naturales protegidas de Livingston



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Izabal

- 1. Área sin protección
- 2. Parque Nacional Río Dulce
- 3. El Higuerito
- 4. Área de Usos Múltiples Río Sarstún
- 5. Sierra de Santa Cruz
- 6. Biotopo Protegido Chocón Machacas
- 7. Reserva Protectora de Manantiales Cerro San Gil



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Bahía de Amatique

Aldea Plan Grande Tatin, Livingston

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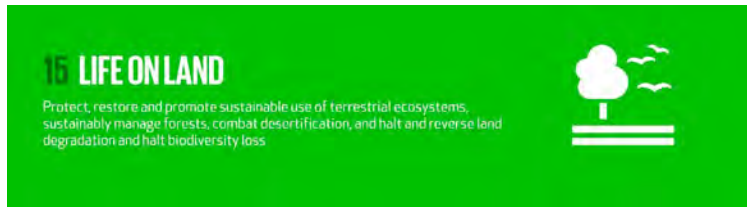
Izabal



- 1. Reserva Protectora de Manantiales Cerro San Gil
- 2. Biotopo Protegido Chocón Machacas
- 3. Área sin protección
- 4. Parque Nacional Río Dulce
- 5. Área de Usos Múltiples Río Sarstún
- Acceso terrestre
- Acceso de tierra

Información de referencia:

- Límites departamentales de Guatemala. (IGN)
- Instituto Geográfico Nacional (IGN) (Hojas 2463 IV y 2463 III)
- Google Map data 2020. Shapes: Sistema Guatemalteco de Áreas Protegidas 2017.
- Cuerpos de agua. Ministerio de Agricultura Ganadería y Alimentación (MAGA)
- Dirección de Análisis Geoespacial del (CONAP), Marzo/2017.



The current Alcalde of Livingston, Mr. Daniel Pinto, together with his team on the Division of International Cooperation, has set the goal of achieving the municipality development in the years 2020-2024 based on the goals and indicators proposed by the 2030 Agenda for Sustainable Development. In this regard, bot FLAAR (USA) and FLAAR Mesoamerica (Guatemala) will collaborate whit this Municipality achieve the Sustainable Development Goal (SDG), number 15 "Life on Land".

Throughout this cooperation project, different materials will be and publishes prepared, as this Photo Essay. These will help to collect information on species, different ecosystems (terrestrial, wetlands and fresh water asociated) and biodiversity. This information will also be useful as it is considered in various conservation estrategias to protect threatened species and prevent their extinction. Moreover, the municipality goals also look forward to promote the sustainable use, conservation and research of the flora and animal species of all terrestrial, wetlands, aquatic shore and coastal associated ecosystems of the Guatemalan Caribbean region. You can learn more about this project and the SDG indicators wich are being pursued at:

<https://flaar-mesoamerica.org/rain-forests-rivers-lakes-bays-ocean-caves-canyons-livingston-the-caribbean-biodiversity-wonderland-of-guatemala/>

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Hellmuth, N. (2021)
 Toxic Root (tuber)?, Arrowleaf Elephant Ear, *Xanthosoma robustum*, Livingston, Izabal, Gutemala: FLAAR Mesoamerica

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BACK COVER PHOTO
Xanthosoma robustum.

All national parks, nature reserves, and comparable are welcome to have and use our reports at no cost. USAC, UVG, URL, Universidad Rural, INTECAP and other Guatemalan universities, and high schools, and schools, are welcome to post our reports, at no cost.

Photo by: Nichollas Hellmuth, FLAAR Mesoamerica, Jan. 19, 2021, 12:54 p.m. Cerro San Gil, Izabal, Guatemala.
 Camera: iPhone 12 Pro Max.

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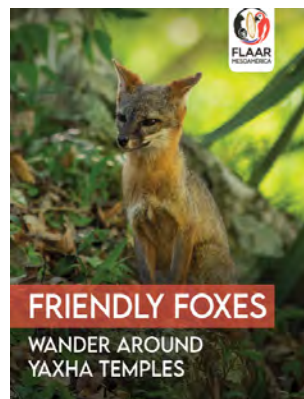
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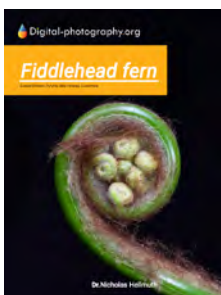
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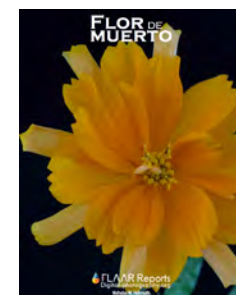
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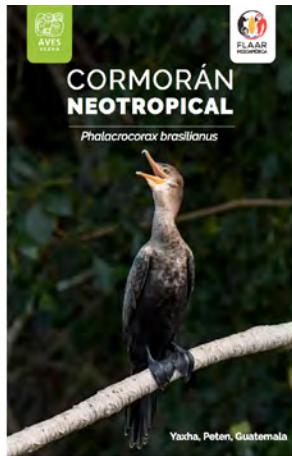


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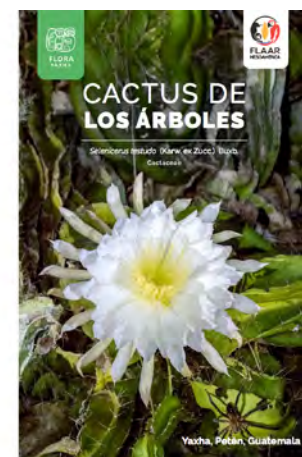
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